VOL. I. FEBRUARY, 1882. No. 5.

PRICE OF THE TRANSACTIONS.

To residents of the City of New York, not members of the Academy, $5.00 per annum. To non-residents, $3.00 per annum, 40 cents per number. To residents and honorary members they are free; extra copies, 30 cents per number.

STATE COLLEGE OF AGRICULTURE AND APPL. SCIENCE LIBRARY JUN 21 1940 MANHATTAN KANSAS

# TRANSACTIONS

OF THE

# NEW YORK ACADEMY OF SCIENCES

1881-1882.

EDITOR,

ALEXIS A. JULIEN,

*School of Mines, Columbia College, N. Y. City.*

PUBLISHED FOR THE ACADEMY,
In Eight Monthly Numbers, from October to May, inclusive.

Feb. 6, 1882.

REGULAR BUSINESS MEETING.

The President, Dr. J. S. NEWBERRY, in the Chair.

Forty-five persons present.

The following named gentlemen, on recommendation of the Council, were elected resident members:

A. D. CHURCHILL. JOHN TOWNSEND.

The Committee appointed at a previous meeting, to prepare resolutions appropriate to the recent death of Dr. J. W. DRAPER,

reported the following minute, which was read by Prof. D. S. MARTIN:

WHEREAS, The recent death of Prof. John W. Draper has removed from among us one of the oldest and most distinguished members of the Academy, and one of the most eminent original investigators in the realm of physical science; therefore,

*Resolved*, That the Academy would hereby express its profound appreciation of the high attainments and honorable services of our late associate, and its sense of sorrow and loss in his departure from our sphere; and that we cannot suffer this event to pass without a brief tribute to his revered and cherished memory.

Prof. John William Draper was born in 1811, at St. Helens, near Liverpool, England. Having received a thorough preliminary education, he was sent to the newly-opened London University, in 1829, that he might study chemistry under Dr. Turner. Urged by relations, he came to America in 1833, and soon afterwards began the study of medicine at the University of Pennsylvania, from which he was graduated in 1836.

Immediately after his graduation, Dr. Draper went to Hampden Sidney College, as Professor of Chemistry and Physiology, to which chair he had been elected before receiving his degree. There he began that remarkable series of investigations which ended only with his life, and which has had so important a bearing on the progress of discovery in several branches of physics. The results of his earlier researches were published in the *American Journal of Science* and in the *London Philosophical Journal;* and, together with later discussions, were collected into one quarto volume, which was published in 1844, under the general title of *The Chemistry of Plants*.

The interest awakened by these earlier investigations secured for Dr. Draper the appointment of Professor of Chemistry and Physiology in the University of the City of New York. He was originally assigned to a chair in the Medical Department, but owing to the financial disaster of 1837, the Medical School was not organized at once, and Dr. Draper began his work in the Collegiate Department of the University, in 1839. He remained in the discharge of his duties until within a few months of his death.

To Dr. Draper is due, in a great measure, the prominence of New York City as a centre of medical education. Previous to 1840, the number of students attending the Medical School seldom exceeded fifty, and oftener fell below. But in that year the Medical Department of the University was organized, and under the management of Dr. Draper, as Secretary of the Faculty, classes of almost 150 students

were graduated. The existence of the school was imperiled in 1865, when fire destroyed its building, with the museum and apparatus; but Dr. Draper succeeded in obtaining temporary accommodations, and the exercises went on without the loss of a single day. Dr. Mott resigned the Presidency of the Medical Faculty in 1850, and was succeeded by Dr. Draper, who retained the position until 1873, when he resigned it in order to devote himself wholly to his duties in the Collegiate Department.

Dr. Draper's lectures on physiology were as eloquent as they were original, and reflected well his daily work as an investigator. They were published in 1856 as a *Treatise on Human Physiology*, which was recognized at once as a substantial contribution to the rapidly developing science of which it treated. This work was the record of observations covering more than twenty years.

The *History of the Intellectual Development of Europe* was but the outgrowth of the work on physiology—a grand expanding of its second portion. It is familiar to most of us, and needs neither description nor discussion here. Soon after the publication of this work, Dr. Draper began the preparation of a *History of the Civil War in America*, which was published in three large volumes. During its preparation he enjoyed exceptional advantages.

After completing the *History of the Civil War*, Dr. Draper returned to those physical studies of which the continuity had been interrupted by his literary labors. During the last ten years of his life he revised his earlier publications, and gave them in condensed form under the title of *Scientific Memoirs*. In these he included also the results of investigations conducted during the preparation of this volume, some of which were of cardinal importance.

It would be difficult to over-estimate the value of Dr. Draper's labors, which are interwoven with the progress of scientific discovery during the last forty years. He was the first to take the human portrait by light, and he was the first to discover and to photograph the lines below the red in the spectrum. He laid the foundation on which Bunsen and Kirchoff reared a noble superstructure, without much regard to the master builder who had preceded them in the work. Of his discoveries in physiology, the most important were made so long ago that they have now become incorporated into the science so fully that the name of the discoverer is rarely mentioned in connection with them.

This Academy should hold the memory of Dr. Draper dear to it. Soon after reaching New York he became an active member of the Academy, then the Lyceum of Natural History. Many of his earlier results were first announced in its meetings, and the proofs of his dis-

coveries were deposited in its collections. When misfortune overtook the Lyceum, when it was deprived of a shelter for its collections and was without a place for its meetings, and when most of its members were ready to desert the organization or to dissolve it, Dr. Draper procured for the Society the privilege of depositing its collections in the building of the University Medical School, and of holding its meetings in the faculty-room of the same building. It may be said that the continued existence of the Lyceum was due solely to Dr. Draper's efforts in that crisis of its history.

Dr. Draper was a diligent student in many fields of research. The great fund of knowledge thus acquired made him rich in illustration, and gave to his writings an eloquence peculiarly his own. He was an ingenious and persistent investigator, with an acuteness of perception which rarely failed to grasp the bearings of facts. He was an earnest and patient instructor, full of a magnetism which attached his pupils to him and awakened an interest in the science which he taught. He was unassuming in manner, but possessed of an indomitable will, and was actuated by a delicate sense of honor in all dealings with his fellow men.

Dr. Draper is gone from among us, but his works will survive him. The field of investigation in which he stood almost alone, forty-five years ago, has now many devoted workers, through whom each year will bring fresh additions to his fame.

*Resolved*, That this minute be published in the Transactions of the Academy.

JNO. J. STEVENSON, } *Committee.*
DANIEL S. MARTIN, }

The resolutions, as read, were unanimously adopted by the Academy.

Notice was given to the Society of the death, since the last meeeting, of Dr. A. L. HOLLEY, one of its Fellows; and, on motion of Mr. ARTHUR H. ELLIOTT, that a Committee be appointed to prepare a similar minute in regard to Dr. HOLLEY, the President named Prof. T. EGLESTON and Mr. ELLIOTT as such Committee.

Prof. A. R. LEEDS exhibited a fine specimen of Natrolite, from the new tunnel now in progress through the Bergen Hill.

Mr. G. F. KUNZ showed a remarkably large crystal of Arkansite, from Arkansas; and also a peculiar hydro-carbon mineral from near Milan, Lombardy, which bore considerable resemblance, in several respects, to the peculiar coal-like peat discussed by Prof. FAIRCHILD at the meeting of Dec. 19th.

Prof. J. S. NEWBERRY then presented the paper of the evening, entitled

COLLEGE OF AGRICULTURE AND APPLIED SCIENCE
LIBRARY
JUN 21 1940
MANHATTAN - KANSAS



THE ORIGIN AND RELATIONS OF THE CARBON MINERALS.

The following is a brief synopsis of the paper, which will appear in full in the Annals of the Academy:

(Abstract.)

1. The so-called "carbon minerals," peat, lignite, coal, anthracite, graphite, petroleum, etc., are not, properly speaking, minerals, as they are without definite chemical formulæ or crystalline forms. They are groups of organic substances, vegetable or animal, the products of progressive changes incident to their nature and reaching their inevitable end in complete oxidation.

2. The principal source from which these substances are derived is vegetable fibre, which consists of organic tissue with a variable quantity of inorganic matter woven into its composition, which remains after oxidation, and is called ash. The organic portion consists, in round numbers, of carbon fifty per cent, oxygen forty-two per cent, hydrogen six per cent, nitrogen two per cent. Like all organic matter, this has been formed under the influence of the vital force, in antagonism to the affinities of inorganic chemistry; and when abandoned by this creative and conservative force, it is necessarily, though more or less slowly, oxidized. When very rapid, this change is called combustion; when less rapid, decay; and when operating very slowly, it becomes a kind of distillation, in which the constituents react upon each other, forming definite or indefinite compounds that retain the solid state or assume liquid or gaseous conditions. In the progress of this change to complete oxidation, an equal amount of force is evolved with that absorbed in the growth of the organic structure. By controlling the exhibition of this force, we utilize it in the form of heat, light, motive power, etc.

3. The changes which take place in organic tissue result in the formation of two classes of products—*residual* and *evolved*. The residual products of the spontaneous distillation of wood-tissue are solids, which are grouped under the conventional and undefinable names of peat, lignite, bituminous coal, semi-bituminous coal, anthracite, graphitic anthracite, and graphite. The evolved products are carbonic acid, carbonic oxide, and numerous hydrocarbon and nitrogenous gases, and the liquids water and petroleums. From the latter, by a kind of spontaneous distillation, are derived non-oxidized solids, paraffine, ozokerite, etc., and oxidized solids, asphalts. From these last are derived asphaltic coals, Grahamite, Albertite, etc.

4. The residual products are portions of a continuous series, beginning with wood-tissue and ending with the ash or inorganic portion left when the organic matter is distilled away, each group showing

considerable diversity of composition, and graduating insensibly into those above and below.

5. The evolved products are given off in all stages of the progressive change. They, too, are usually mixtures when eliminated, and are constantly changing by the absorption of oxygen and conversion into their final state, carbonic acid.

6. The escape of the evolved products is constantly taking place from all great accumulations of carbonaceous matter; the gases commonly and the liquids occasionally are seen escaping from beds of coal; and both abundantly from the much greater accumulations of carbonaceous matter in bituminous shales, gas and oil springs being inseparably connected with the outcrops of all these great deposits. Coal and petroleum also spontaneously change when exposed to the air, the coal rapidly losing its volatile constituents, and with them its value for the manufacture of gas and coke; petroleums becoming by evaporation and oxidation thicker and darker, finally forming asphalt, or without oxidation, paraffine, ozokerite, etc.

7. The differences which we observe in the residual and evolved products are in part due to peculiarities in the organic tissue from which they are formed, and in greater degree to the stage of distillation that they have reached. Different kinds of vegetation, as oaks, pines, ferns, algæ, etc., having somewhat different compositions, yield diversified products in distillation; and petroleums, though mainly derived from cellular plants (seaweeds, etc.), are in part the products of the distillation of animal matter, and owe some of their characteristics to that fact.

8. Every step in the process described above is abundantly illustrated in our coal and oil fields, all of which have been studied by the speaker. The views presented are not the coinage of the imagination, but a simple transcript from nature; and they are sustained by such an array of facts as to compel their acceptance. Instances were given of the conversion of lignite into coal, anthracite and graphite, by volcanic action, and of the natural derivation of asphalt, asphaltic coals, and anthracite, from petroleums.

9. Further the great work going on in nature's laboratory may be closely imitated by art; the differences in the results being simply the consequence of differing conditions in the experiments. Vegetable tissue has been converted artificially into the equivalents of lignite, peat, anthracite and graphite, with the emission of vapors, gases and oils, closely resembling those evolved in natural processes. So petroleum may be distilled to form asphalt, and this in turn converted into Albertite and coke (*i. e.*, anthracite). Grahamite has been artificially produced from petroleum by Mr. W. P. Jenney.

10. The theories proposed by Berthelot, Daddow, Byasson, and Mendelejeff, for the genesis of petroleum, are the results of speculation in the study or irrelevant experiments in the laboratory, and have no confirmation or illustration in the facts of nature.

---

February 13, 1882.

SECTION OF PHYSICS.

The President, Dr. NEWBERRY, in the Chair.

Forty persons present.

Prof. ROBERT H. THURSTON read a paper,[1] entitled

ON THE BEHAVIOR OF STEAM IN THE STEAM-ENGINE CYLINDER, AND ON CURVES OF EFFICIENCY.

(Abstract.)

In an earlier paper[2] the writer had shown what are the conditions determining the ratio of expansion in steam engines working at maximum efficiency, and how those conditions vary in different types of engine, and also how essentially different is the actual working engine, in all that effects that ratio, from the hypothetical case usually taken, in which the steam is assumed to expand adiabatically in a non-conducting steam-cylinder. It was finally shown what were the best values of this ratio for several standard types and representative cases, as determined by the writer by direct observation and by the study of experimentally obtained results, the precise figures given being obtained by rules of simple form so deduced.

It was shown that first friction and then—often to a vastly greater extent—cylinder condensation, due to expansion of a heated fluid in a working cylinder made of a material of high conducting power, modify the methods of expansion and of expenditure of heat so greatly that the ratio of expansion for maximum efficiency, in unjacketed engines, rarely exceeds $\frac{1}{2}\sqrt{P}$, where $P$ is the gauge pressure in pounds per square inch, although its value would otherwise be, often, several times greater. It was also shown that these modifying conditions very differently affect different kinds of steam engine, and different engines, and also individual engines, at various pressures and piston speeds.

In this paper it was proposed to show more fully what is the behavior of steam in the steam-engine cylinder and to exhibit the form taken by the expansion-line; to give values of mean pressures obtained under

[1] Published in full in the Journal of the Franklin Institute, February, 1882.

[2] On the Ratio of Expansion at Maximum Efficiency in Steam Engines; Trans. Am. Soc. Mech. Engrs., 1881; Jour. Franklin Institute, May, 1881.

various conditions, and finally, to show the method devised by the author for laying down curves of efficiency, and to show what conclusions follow from their study.

It was shown that in no case, in steam engines as to-day constructed, can the expansion-line or the curve of mean pressures be such as would be obtained in a non-conducting cylinder. Steam must always be more or less condensed at the beginning and must always carry away heat by its re-evaporization at the end of the stroke. The steam-jacket checks the first operation, but accelerates the last, and, with wet steam, may scarcely decrease the evil that it is designed to prevent.

It was stated that the adiabatic curve may be closely represented by a regular curve of the hyperbolic class, $p_1 v_1^n = p v^n$, the exponent $n$ varying with the proportions of steam and water in the mixture at the commencement of the expansion, which is assumed to take place in a non-conducting cylinder. Zeuner finds the value of $n$ to be nearly $n = 1.035 + 0.1\, x$, $x$ being the proportion of steam present.

Table I, appended to the paper, gave the values at the ratio of mean pressure to initial pressure $\frac{p_m}{p_1}$, for various mixtures from steam 1.00, water 0, to steam 0.50, water 0.50, assuming the formula to be practically accurate within that range.

With these are given the adiabatics for superheated steam, $n = 1.333$.

Table II gave the values of $\frac{p_m}{p_1}$ for steam-expansion in a jacketed metal cylinder, in which it is kept just dry and saturated by heat from the jacketed sides and ends; the values for wet air compressed in air-compressors, in which $n$ is frequently found to be 1.2; and for peculiar cases in actual steam engines in which leakage or re-evaporation, or both, raise the terminal pressures greatly, giving $n = 0.50$, $n = 0.75$.

It is, as yet, impossible to predict which of these curves will be found in ordinary engines, and the engineer is compelled to rely entirely upon the "indicator" for information of this character; this instrument gives him a more or less exact graphical representation of the changes of pressures and volume throughout the stroke. The greatest possible variety of curves are found to occur in such cases, but they approach the adiabatic more nearly, as the steam is drier and, as the speed of piston is increased, rarely departing far from the common hyperbola in good engines.

The values of $\frac{p_m}{p_1}$ given in the tables are plotted on Plates I and II, and from these a better idea can be obtained of the method of variation of mean pressure and of work done with variation of the ratio of

expansion, and a better notion of the relation of these several curves gained, than by the study of the tabled quantities.

The writer next describes the curves of efficiency, of work and of mean pressures, to be obtained where steam is expanded in a non-conducting cylinder. They are easily deduced and easily constructed, and, by reference to Zeuner's formula, the engineer can determine them with a satisfactory degree of accuracy for all cases likely to arise in his practice.

Next, studying the behavior of steam in a metallic cylinder, he finds vitally different conditions and results; but given the law of variation of composition of the mixture with change of point of cut-off, or of ratio of expansion, it is, nevertheless, not only practicable but easy to determine curves of efficiency and to deduce values of the best ratio of expansion for any given case.

Where direct experience can be resorted to, to determine the cylinder condensation, it is easy, as shown later, to obtain *exact* results when seeking the ratio of expansion at maximum efficiency of fluid, of engine, or of capital, or in the solution of a rarer case which requires that the point of cut-off which gives most work for a given expenditure on the whole plant be determined.

The author describes and illustrates the construction and application of curves of efficiency for real engines, in the solution of important problems, and concludes by summarizing his work and leading the reader to the final deductions:

"The curve of variation of efficiency above traced, of which the abscissas measure varying quantities of steam used in a given steam-cylinder, while the ordinates are proportional to the quantities of work done by those amounts of steam, is a curve of entirely different character and form, and often widely different in location, from the curve of adiabatic mean pressures or other curve of mean pressures exhibiting the work done by various quantities of steam expanding under given fixed conditions in a non-conducting vessel.

"That no predetermination of the efficiency of any proposed engine, whether of fluid, of machine, or of capital, can be made unless the true curve of efficiency can be obtained for the assumed case.

"That the most certain and the most satisfactory solution of any problem of efficiency will be that obtained by first securing the elements of the curve of efficiency from actual engines operated in the manner proposed for the case taken.

"That having obtained by experiment upon any engine, the 'curve of efficiency,' as defined by the writer, the efficiency of fluid, of engine, and of capital expended to do a given amount of work, and the quantity of work to be obtained most cheaply from a given engine, may all

be obtained for any given set of conditions, and the ratio of expansion at maximum efficiency, of fluid, of engine and of capital, and the ratio of expansion which, with a given plant, gives most work for a dollar of expense of operation, may all be determined with a degree of exactness only limited by the magnitude of the errors of observation.

"That the necessity of following the direction of improvement pointed out and entered upon a century ago, by Smeaton—the protection of the working fluid from losses of heat, by surrounding it with non-conducting surfaces—constitutes the most imperative of all demands to-day upon the mechanical engineer engaged in designing steam engines."

Prof. W. P. TROWBRIDGE made some remarks on the paper of Prof. THURSTON, expressing his high appreciation and interest, and treating of the importance of the subject.

Professor CHARLES F. HIMES, of Carlisle, Pa., presented the following paper, which in his absence was read at his request by Mr. W. LE CONTE STEVENS:

## STEREOSCOPIC NOTES.

The interesting and exhaustive papers lately written by Mr. W. LE CONTE STEVENS have recalled corroborative experiments in a similar direction, made by myself about 1860, while critically examining the brochure[1] published by Sir DAVID BREWSTER, which did so much in connection with the lenticular stereoscope devised by him, and the rapid multiplication of photographic slides for it, to popularize the beautiful discovery of Wheatstone. By experiments with large photographs, specially prepared, without instrumental assistance, I found, as Mr. Stevens has in his experience, that convergence of the optic axes to a positive point was altogether unnecessary for the production of stereoscopic effect, as published in 1862 and subsequently,[2] and therefore that the binocular criterion of distances, as so clearly enunciated by Bishop BERKELEY in his *Theory of Vision*, must consist in movement of the optic axes successively converged on different points of an object, rather than in the degree of convergence of the axes.

At the same time, while experimenting upon the application of the stereoscopic principle to the solution of some scientific and metaphysical problems, I was led to discard the rather complicated and unsatisfactory diagram suggested by Sir DAVID BREWSTER for the explanation of the *Phenomenon of the Horizontal Moon*,[3] as well as the somewhat better one suggested by Professor RUETE,[4] and to

1 The Stereoscope, London, 1856.

2 Am. Jour. Phot., Sept. 1, 1862; Journal of the Franklin Institute, Phila., Vol. XCII. (1871), Nos. 549, 550, 551; Vol. XCIII., Nos. 553, 556, 556, 558.

3 The Stereoscope, p. 201.

4 Das Stereoscop, Leipzig, 1860, p. 86.

substitute one more in accordance with the theory of rapid successive convergency of the optic axes in the estimation of distance. The effect was a decided surprise in its illustration of the phenomenon, but even more so as a corroboration of the theory. It consisted simply of two concentric circles, respectively 1⅝ inch and ⅞ inch in diameter as the left-eye picture, and a circle 1⅝ inch in diameter, enclosing two circles ⅞ inch in diameter each, with their centres respectively 1-10 inch to the right and left of the centre of the large circle, as the right-eye picture, the centres of the large circles being about 2⅝ inches apart. The expectation was, that the successive combination, so to speak, of the small circles of the right-hand figure, could at least be made so rapidly that a comparison of the sizes could be made at the varying apparent distances. The apparent *simultaneousness* of the appearance of the near and remote circles, with the expected difference in apparent size, constituted the surprise, which has been experienced by every one upon examining such a slide for the first time. Attention was called to the diagram in a published discussion of some of Sir DAVID BREWSTER'S views of the theory of the stereoscope in 1864, in the *British Journal of Photography;* and subsequently a dealer in stereographs placed it among his slides; but it is more than possible that even those interested in this subject may not have met with it, and I have therefore presumed to call attention to it in connection with the very interesting articles upon the subject before alluded to.

CARLISLE, Pa., January 30, 1882.

Mr. STEVENS exhibited the stereograph described by Professor Himes, and by large diagrams on paper explained the difference between this and Brewster's method of illustrating the phenomena of the horizontal moon. In addition, he remarked substantially as follows:

"It gives me much pleasure to present this paper by Professor HIMES, and to call attention to his careful observations on the nature of binocular vision, which were made twenty years ago, and have not received the full notice to which they were properly entitled. The great name of Sir DAVID BREWSTER carried with it a degree of authority which caused the general acceptance of the geometric theory of binocular vision. Professor W. B. ROGERS,[1] in this country, had also written a series of very able papers, in which he calculated what must be the form of the externally projected binocular image, assuming each point of this to be determined by intersection of visual lines. Professor HIMES discovered that such intersection is not necessary; but, unfortunately, his paper on this subject was not published in the *American*

1. Am. Jour. Science, vols. XX. and XXI., 1855 and 1856.

*Journal of Science.* (Mr. STEVENS here read an extract from the original paper, published by Professor HIMES, in the *American Journal of Photography* for September 1, 1862.) Shortly before the appearance of this paper, two Germans, ROLLET and BECKER,[2] published a method of securing binocular fusion of similar images with optic divergence, the possibility of such fusion having been already mentioned by BURCKHARDT. Professor HIMES' experiments were doubtless contemporaneous with those of the Germans just named, and were wholly independent of them.

"My own discovery of the possibility of stereoscopic vision by optic divergence was likewise independent. I subsequently learned of the previous experiments on this subject by ROLLET, BECKER, and HELMHOLTZ, and duly credited them in my paper before this Academy on the 6th of last June. Professor HIMES' papers were sent me after mine had been published in the *American Journal of Science* for last November. He deserves the credit of being the first in the country to secure stereoscopic vision with conscious optic divergence. My own claim is based rather upon the analysis than the discovery of this mode of stereoscopy. For years past, oculists have subjected their patients to the use of prisms for the purpose of testing the strength of the external rectus muscles of the eyeballs, in diverging the visual lines while the eyes receive, from an object in front, rays of light that are refracted by transmission through the glasses. In view of this fact, it is remarkable that BREWSTER'S geometric theory of stereoscopic vision should still hold its place in our text-books of physics. His theory of color has been abandoned, and his theory of binocular perspective is awaiting the same fate.

"In regard to the phenomenon of the apparent enlargement of the moon when seen at the horizon, Professor HIMES' stereograph gives an excellent illustration, superior to that of BREWSTER,[3] because the two parts, which are to be contrasted in the external projection of the binocular image, are more nearly aligned, and no motion of the stereograph is necessary. While the angular diameter of the moon remains nearly constant, being slightly greater when near the zenith, because the observer's true distance is diminished by nearly the earth's semi-diameter, its apparent magnitude varies with its estimated distance, and it appears much smaller when near the zenith, instead of larger. The cause of this illusion of distance, producing an illusion in regard to size, which is well illustrated by the present stereograph, has been the subject of much discussion. In so late a book as LOCKYER'S *Astronomy*,[4]

2. Helmholtz, Optique Physiologique, pp. 827, 828.
3. The Stereoscope. London, 1856, p. 201 *et seq.*
4. Elements of Astronomy, Appleton & Co., N. Y., 1873, p. 116.

COLLEGE OF AGRICULTURE AND APPLIED SCIENCE
LIBRARY
JUN 21 1940
MANHATTAN
STATE - KANSAS



(1873), it is attributed to unconscious comparison with terrestrial objects at the horizon. If such be sufficient, there should be no apparent enlargement when the rising moon is seen upon a calm ocean; but this is the condition under which the phenomenon is really most striking. For the following brief sketch of the views that have been held, I am indebted mainly to HELMHOLTZ.[5]

The first opinions put forth on the perception of the third dimension in space were in connection with these differences of apparent size of the moon.

PTOLEMY (A. D. 150) said that the mind judges of the size of objects in accordance with the previous appreciation of their distance; this would appear greater when there are many intervening objects, since this occurs when the heavenly bodies are near the horizon. Nevertheless, he elsewhere attributes the enlargement to the refraction of rays by vapors.

ALHAZEN (1038) refutes the latter opinion and returns to the first. He is followed by ROGER BACON, and opposed by BAPTISTA PORTA.

VITELLION (1271) accords with ALHAZEN, and observes additionally that the whole celestial vault appears more elongated horizontally than toward the zenith.

KEPPLER (1604), whose opinion was adopted by DESCARTES, said that the distance between the two eyes is the base which we employ in measuring the distance of objects. We have here the first enunciation of the binocular theory afterward so emphasized by BREWSTER. KEPPLER adds that since, in making measurements with the two eyes, we learn to make them with the single eye, the magnitude of the heavenly body, as perceived in the eye, would serve as a base for distances relatively slight. We furthermore appreciate different degrees of light, and practically compare the size of an object with its distance, since we know by experience how much to extend the hands or to advance toward an object to touch it. KEPPLER thus knew the most important elements of the appreciation of distance, aside from that of dissimilarity of images.

The subject has been further considered by GASSENDI (1658), HOBBES (d. 1679), MOLYNEUX (1687), DE LA HIRE (1694), PERE GOUYE (1700), BERKELEY (1709), R. SMITH (1728), LOGAN (1736), DESAGULIERS (1736), BOUGUER (1755), PORTERFIELD (1759), SAMUEL DUNN (1762), MALEBRANCHE (1764), LAMBERT (1765) and EULER (1768).

The opinions expressed by these writers need not be repeated, except to say that BERKELEY insisted upon the dim and pale aspect of

5. Optique Physiologique, p. 870 *et seq.*

the moon at the horizon, attributing the judgment of increased distance to aerial perspective, as it is viewed through a thicker bed of air. This is unquestionably one of the most important elements, but BREWSTER[6] specially denies its value in the present case. Dr. R. SMITH made a series of estimates, sometimes toward the horizon, sometimes toward the zenith, and found that the distance of the horizon appeared from three to four times greater than that of the zenith.

HELMHOLTZ[7] gives reasons why the celestial vault should appear flattened, even though there is no such limiting surface to the space overhead. The path of the visible moon is referred to this imagined semi-ellipse; and to this circumstance, combined with aerial perspective, is mainly to be referred the illusive judgment of variation in its distance.

This illusion is by no means confined to our estimation of the distance of heavenly bodies. Most persons have probably observed the apparent magnification in distance of the ground when viewed from a lofty window compared with that of the window when viewed from the ground. In this case aerial perspective can scarcely be considered, and there is nothing to produce the illusion of a geometrically regular surface below. It seems highly probable that physiological rather than mathematical conditions are operative in producing the illusion."

Mr. W. LE CONTE STEVENS exhibited

A NEW REVERSIBLE STEREOSCOPE.

The objects to be attained in constructing this stereoscope were —

I. To secure ready motion to the semi-lenses, so that they may be adapted in position for any pair of eyes, whatever may be the interocular distance, and for any stereograph, whatever may be the stereographic interval within the usual limits.

II. To secure ready motion to the screen, so that the whole stereograph, or either separate half of it, may be visible to each eye, at will.

III. To secure the possibility of removing the semi-lenses, so that they may be reversed in relative positions, or be substituted by prisms with their bases toward each other, so that the left and right pictures may be simultaneously viewed, without discomfort, by the right and left eyes respectively, thus securing reversion of relief in the binocular image, if desired.

IV. To secure the means of examining the binocular image either alone or attended by monocular images, so that the difference between the two kinds of vision may be noted.

V. To secure the means of using the same instrument, either with

6. The Stereoscope. London, 1856, p. 101 *et seq.*
7. Optique Physiologique, p. 800 *et seq.*

glasses or for binocular combination of images by direct vision, and to reduce the difficulty usually attendant upon stereoscopic vision by the latter method.

VI. To secure the means of producing stereoscopy from perfectly similar pictures by making the retinal images of these dissimilar.

The construction and manipulation of the instrument was illustrated in full; but a description of this is not given in the present abstract, because already furnished to the *American Journal of Science*. A printed description also accompanies each instrument, as issued by the manufacturers, Messrs. E. & H. T. ANTHONY & Co., 591 Broadway.

The feature in binocular vision, mentioned in paragraph VI. above, has not been explained hitherto, and has been but rarely perceived. If an object possessing three dimensions in space be held within a short distance and viewed alternately by the right and left eyes, the retinal images of it at these different standpoints are necessarily dissimilar. On this principle depends the whole art of stereoscopy, as illustrated with the instruments and stereographs in ordinary use. Each of the latter consists of two pictures of an object, taken from different points, so as to secure dissimilarity. The binocular combination of their retinal images hence presents the appearance of solidity, independently of any perspective effect secured by art.

If a large plane surface, on which are drawn similar figures regularly recurring at equal distances apart, be appropriately viewed with very strong cross vision, so that a phantom image, reduced in size, is seen in mid-air, the latter appears slightly curved, with the convexity toward the observer. This mere fact was first noticed by Sir DAVID BREWSTER, but on his theory of visual triangulation, the phantom image should be a plane, parallel to the given plane. The appearance of any convexity would disprove his theory, and BREWSTER undertook no explanation of what was to him, under the circumstances, probably not a striking phenomenon. This long-forgotten peculiarity of the phantom image, or at least its curvature in one direction, has lately been rediscovered by Professor LE CONTE, and its curvature in all directions by myself. It was at first regarded as one of the consequences of strong convergence of visual lines. By using, instead of a large plane surface, a card on which the two pictures are perfectly similar, such as a pair of series of concentric circles, and cutting the two halves apart, the horizontal visual lines may be made parallel while the two small cards are oppositely inclined to them, at any desired angle, by rotation about a pair of vertical axes. Each plane may thus bear to the visual line that meets it the same relation that would result from strong convergence or divergence in viewing a single continuous plane. The binocular effect is that the combined surface appears convex or concave, at will, by varying the

angle formed by the planes of the cards on which the pictures have been have made.

Mr. STEVENS proceeded to explain and illustrate these effects in a series of diagrams, showing how this curious and novel result is due to the fact that, through the crystalline lenses, the images of the similar drawings, obliquely viewed from opposite sides of the normal to each picture, are projected upon retinal surfaces which are not planes, but nearly spherical, and hence are slightly dissimilar.

The full description of the reversible stereoscope, and the geometric discussion of the new method of stereoscopy, may be found in the *American Journal of Science* for March and April, 1882, the *London Philosophical Magazine* for April and May, 1882, and the *Popular Science Monthly* for May and June, 1882, in which latter it will appear as an illustrated article.

---

Feb. 20, 1882.

LECTURE EVENING.

The President, Dr. NEWBERRY, in the Chair.

The hall was completely filled.

Mr. WM. E. HIDDEN exhibited an extraordinarily large crystal of Monazite, from North Carolina.

The second lecture of the regular monthly course was then delivered, by Dr. J. S. NEWBERRY, upon

THE ANCIENT CIVILIZATIONS OF AMERICA.

(Abstract.)

Two distinct civilizations have left their traces in different parts of North and South America: 1. That of the Mound-Builders in the Mississippi Valley; 2. That of the Stone House or Temple-Builders of the table-lands of North America, the Isthmus, and the western coast of South America.

Of these the relationship is obscure, and no certain proof has been furnished of their synchronism or their genetic connection.

(I.) The whites, on their advent, found the east coast of North America covered with dense forests, and inhabited by wild animals and the nomadic Indians. It was only when the wave of migration had reached the basin of the lakes and the valley of the Ohio, and the forest was then cut off, that mounds, earthworks, mines, etc., were brought to light, which prove that this region had for ages been occupied by a numerous, sedentary, and partially civilized people. The date of their occupation of the Mississippi Valley cannot be accurately determined. Their works had been abandoned and overgrown by the

forest at least a thousand years—as shown by two generations, living and dead, of mature forest trees which covered them.

These ancient people were agricultural in pursuits, built towns of considerable size, and left such abundant traces as to prove that the population of the region they occupied was as great as the present one.

The degree of advancement in the arts which the relics of the Mound-Builders exhibit is such as to raise them above the condition of absolute savagery, but they were hardly civilized in the present acceptation of the term. Their works were varied in character, and frequently of imposing dimensions, and consisted of fortifications, sepulchral mounds, and extensive structures designed apparently for ceremonial and religious purposes. These are all of earth or rough stone, and there is no evidence of any progress in the mason's art. The buildings were probably of wood, the foundations alone remaining. These people worked the copper-mines of Lake Superior, the oil-wells of Pennsylvania, Ohio and Michigan, the lead-veins of Kentucky, and the mica-mines and steatite-quarries of the Alleghany range; but all this mining in the rock was done by means of stone and wooden implements, and the use of fire; they left no evidence of the possession of other metals than copper, and this was used only in its native state, was never melted, and was fashioned by hammering. They had woven fabrics made with considerable skill from the fibres of plants. Their pottery was generally coarse in material and rude in form, but in some instances was graceful in shape, made of finer clay, and ornamented with incised or painted designs. Their burial ceremonies were apparently elaborate, and cremation was often practiced. Their bones have generally been found decomposed by age; but from such as have been preserved, we may infer that in proportions and form of cranium this race resembled the average Indian, and that they belonged to the great American family of man.

We have as yet no evidence of their possessing domestic animals, and no accurate information in regard to their crops, except that maize was their great staple.

The wide distribution of marine shells throughout the interior of the continent—used for implements or ornaments, of beads, and of mica and copper, soapstone and flint, all from known localities shows that there was considerable internal commerce, but no positive evidence exists of interchanges with foreign nations. The discovery in the mounds of tablets, engraved with symbols or ornaments of a Mexican type, indicates communication with the civilized occupants of the table-lands; but the rarity of these relics and the absence of monuments from a broad space separating their countries, leads to the inference that their intercourse was limited and their relationship not close.

The fate of the Mound-Builders was for the most part extermination by incursions of the more warlike northern nomadic Indians, who had occupied the whole country at the advent of the whites; but it is probable that in the Mandans and Natchez some remnant of the Mound-Builders continued to exist after the occupation of America by Europeans.

(II.) The table-lands of North America, from Salt Lake to the Isthmus, are thickly set with the remains of a civilization much more advanced than that of the Mound-Builders. These are the works of a people at one time far more numerous than at present, though still represented by scattered colonies in our southwestern territories, and found in the occupation of Mexico by Cortez. They were characteristically workers in stone, and have everywhere left monuments of their skill in constructive masonry, which inspire respect and often admiration. The structures raised by this people are mostly communal houses and compactly built towns, but they are often citadels and watch-towers. Many of these are erected with special reference to defence—their exterior walls being unbroken to the height of 15 or 20 feet, and the interior accessible only by ladders. In many instances the towns and houses are located on high and almost inaccessible rocks, evidently with a view to defence. A few of the towns within our own territory, peculiarly well defended by their natural positions, continue to be occupied to the present day—such as the Moqui villages, Acoma, Zuñi, etc.—but most of the area where once a dense population existed has been entirely abandoned. Every available inch of arable land seems to have been cultivated by them, hill-sides terraced, and water for irrigation and drinking brought many miles in canals, and stored in well-built stone cisterns. In the northern provinces of the country inhabited by this people metals seem to have been unknown, and all wood and stonework was accomplished with stone implements.

The modern representatives of these ancient people are peaceful, industrious, ingenious, temperate and moral; they cultivate the soil with great care, and are well clad in softly dressed skins of sheep and deer, or in woolen garments woven by hand, but often very tastefully ornamented and serviceable. They excelled in the manufacture of pottery, which is often graceful in form, and elaborately ornamented with colored designs.

The metropolitan population of Mexico was, however, further advanced in the arts, having well-built and paved towns, good roads, with relay stations for couriers, parks, fountains, courts of justice and police. They also had a written language and picture writing, both on paper, with elementary and professional schools. They employed a

number of the metals, gold and silver as ornaments, tin and copper combined to form bronze, which was used for arms and utensils. The structures which they erected were frequently composed of stones of large size, carefully dressed and laid in mortar, with the interiors plastered and painted. The external architectural decoration was frequently exceedingly elaborate and often very tasteful. Their religion was apparently sun-worship, and they frequently offered human sacrifices.

The monuments of Central America and Peru show such resemblance to those of Mexico, that we cannot doubt that the people occupying all these countries must have been in close communication, and intimately related. The monuments of Central America have been described and illustrated by Stevens and Catherwood, Waldeck, Norman, etc., and their number, magnitude and ornamentation have excited great interest and admiration; but it is believed that only a small portion of these monuments has yet been examined, and that in the dense forests of Honduras and Yucatan there yet remain a large number of towns and individual structures to reward the efforts of future explorers.

In Peru, as in Central America, the population in possession of these countries at the time of the Spanish conquest was the same that had erected the monuments; but in both, as in Mexico, the iron hand of despotism and religious bigotry has nearly exterminated the population, and has destroyed their records, until their characteristics and history are scarcely better known than those of the Egyptians and Assyrians.

The monuments of the Incas and their predecessors in South America are briefly described by the Spanish historians, and have lately been studied by one of our number, Mr. E. G. SQUIER; and their magnitude and interest may be inferred from his statements that the masonry of some of the Peruvian buildings excels anything he has elsewhere seen; that the great Incarial roads extending from Quito to the frontiers of Chili were constructed with more labor and engineering skill than our Pacific Railroad, and that one fortress guarding a pass in the Andes contains more masonry than all of our coast defences from Maine to Florida. Although exhibiting local differences, the similarities in the remains of the ancient inhabitants of Mexico, Central America and Peru, are such that we are compelled to believe that their civilization was generically the same, and that all these peoples were offshoots from a common stock. The monuments in Central America are often covered with inscriptions, while these are almost wanting in Mexico and Peru; but both these peoples used paper for writing, and were as little in the habit of making inscriptions on stone as we are, or as most civilized nations of Europe. Therefore the absence of inscriptions cannot be accepted as evidence of inferior enlightenment.

Everything indicates that the civilization of Central America, Mexico and Peru was indigenous, and sprang from a common source, spreading along on the west slope of the Cordilleras from Chili to Central America, and northward to the fortieth parallel. Throughout this region the phases of development were essentially alike, and it is probable that constant intercourse was maintained by sea between South and North America.

The origin of this peculiar civilization is a problem not yet solved, but it is almost certain that it borrowed nothing from Europe, Africa or Asia.

Some facts seem to indicate that it was a growth from seed imported from India by way of the Pacific Islands, many of which contain stone monuments and structures which have a striking resemblance to those of the west coast of America.

Dr. NEWBERRY spoke somewhat fully of his own observations and experiences among the Zuñi villages, at a time when scarcely any Americans had ever before visited them; and also of the peculiar remains of ancient mining operations in the Lake Superior copper-region and in certain of the oil-wells of Pennsylvania and Ohio, as studied by himself. At the close of the lecture he showed a number of very finely-wrought pieces of ornamental weaving obtained among the Pueblo tribes, and a large series of lantern views illustrating the several topics treated of in the course of the lecture.

---

February 27, 1882.

ANNUAL MEETING.

The President, Dr. NEWBERRY, in the Chair.

Thirty-eight persons present.

The report of the Treasurer, Dr. JOHN H. HINTON, was read.

The principal receipts during the year had been: from initiation fees and annual dues, $1,535.00; from interest on bonds, $152.00; from subscriptions to and sales of the Annals, $335.86; and from contributions to the Patrons' Fund, $100 each from Professor A. R. LEEDS and Mrs. HENRY HERMANN. The chief items of expense had been: $500 for binding portions of the library, and $689.68 for printing and engraving (Annals, circulars, notices of meetings, etc.); for rent of the society's rooms there had been paid, $469.50; and for three U. S. 4 per-cent bonds (to Patrons' Fund), $354.37.

The report of the Recording Secretary, Dr. O. P. HUBBARD, was presented.

Thirty-four sessions of the Academy and eight meetings of the

Council had been held during the year. The papers and communications presented at the meetings had been very varied and valuable. Besides five public lectures, fifty-five formal communications had been made before the Society, which might be classified generally as follows: Archæology, 2; Biology, 3; Chemistry, 4; Geology, 18; Mineralogy, 17; Physics, 11. The average attendance at twenty-four meetings had been forty.

There had been added to the resident membership during the year, twenty-six persons; fourteen had resigned, and two had died—JOHN W. DRAPER, M. D., LL. D., and ALEXANDER L. HOLLEY, E. M.

The Secretary suggested the propriety of further efforts to enlarge the membership of the Academy.

In the absence of the Librarian (Dr. ELSBERG) the President addressed the meeting in reference to the library, reporting the great amount of work that has been done during the past two years, in arranging, cataloguing, and binding the books and pamphlets. The heavy expenses involved in this most necessary and important work have severely taxed the Academy's finances; but as the work is now substantially done, and the chief expenses over, the Society is to be most heartily congratulated in the matter. The great and valuable library is now, for the first time in many years, brought into a satisfactory condition; and having permanent quarters in a positively fireproof building, its security and utility are assured.

Prof. THOMAS EGLESTON reported further in the same strain, in behalf of the Library Committee. He presented to the Society the question of employing a paid librarian, which was referred to the Council; and announced that the arrangements were so far completed in reference to the binding and arranging of the books, that the library would be formally opened for use by June.

The Corresponding Secretary, Dr. A. R. LEEDS, presented his report, relative to the correspondence of the Academy during the year.

Prof. D. S. MARTIN presented the report of the Committee on Publications. The "Annals" of the Academy had been carried on as usual—Nos. 5 and 6, of Volume II, having been issued before the summer adjournment of the Society; and Nos. 7 and 8, which had been unavoidably delayed, being nearly through the press, and very soon to appear. Besides this, a large amount of labor had been expended during the summer and fall of 1881, in the preparation and issue of the Index to Volume I.

The publication of a journal of the Academy's meetings, with the briefer papers and discussions, which had been so long desired and aimed at, had finally been undertaken in the printing of the TRANS-

ACTIONS. This had been accomplished largely by the care and pains taken by Dr. A. A. JULIEN, who had concluded arrangements with the weekly journal, "Science," to publish regular reports of the Academy's proceedings, after which the type could be re-arranged so as to issue the record in a pamphlet form for free distribution to the members. Mr. MICHELS, the editor of "Science," had been very accommodating in the whole matter; and the result was that the TRANSACTIONS could thus be issued at a very moderate cost to the Society. This publication had now been undertaken as an experiment, for one year; and it is hoped that the movement would be so sustained as to assure its permanence.

A change was recommended in the price of the "Annals," from $2 (which rate would be continued to resident members) to $3 for non-residents, and $5 for persons living in the city and not members of the Academy. The TRANSACTIONS are to be sent free of cost to resident members, and furnished to others at the same prices as those just mentioned for the "Annals."

Prof. T. EGLESTON addressed the Society with reference to the approaching Convention to be held at Washington, in regard to the question of organizing the system of International Time, and selecting standard meridians. He recommended that the Academy should take action similar to that of some other scientific bodies, in appointing a delegate to that Convention.

Prof. JOHN K. REES was nominated as such a representative of the Academy, and unanimously elected.

The Society then proceeded to the annual election of officers, with the following result—all being chosen unanimously, save a very few scattering votes:

*President,*

JOHN S. NEWBERRY.

| *First Vice-President,* | *Second Vice-President,* |
|---|---|
| BENJAMIN N. MARTIN. | ALEXIS A. JULIEN. |
| *Recording Secretary,* | *Corresponding Secretary,* |
| OLIVER P. HUBBARD. | ALBERT R. LEEDS. |
| *Treasurer,* | *Librarian,* |
| JOHN H. HINTON. | LOUIS ELSBERG. |

*Council,*

| | |
|---|---|
| DANIEL S. MARTIN, | GEORGE N. LAWRENCE, |
| THOS. EGLESTON, | W. P. TROWBRIDGE, |
| ALFRED C. POST, | LOUIS ELSBERG. |

STATE COLLEGE OF AGRICULTURE AND APPLIED SCIENCE
LIBRARY
JUN 21 1940
MANHATTAN - KANSAS

*Curators,*

BERNARD G. AMEND, B. B. CHAMBERLIN,
CHARLES F. COX, HERMAN L. FAIRCHILD,
WM. H. LEGGETT.

*Finance Committee,*

T. B. CODDINGTON, PHILIP SCHUYLER,
THOMAS BLAND.

THE PRESIDENT elect addressed the meeting, with a brief review of the work and progress of the Academy during several years past, its growth in numbers and in means, the increasing activity of its meetings, and the various grounds for encouragement and congratulation, albeit in the face of many obstacles, and the duty and responsibility of the members, and of all lovers of science and intellectual culture in the community, to sustain and further the interests and aims of the Academy.

---

Prof. A. R. LEEDS presented the following communication:

DIPHENYLAMINE–ACROLEIN.

Twenty-five grms. of diphenylamine in alcoholic solution were treated with acrolein in excess, and, after standing, the loosely-corked flask was gently warmed for a number of hours, until the smell of acrolein had nearly disappeared. A bulky, dark red precipitate was formed. On boiling with alcohol a deep red solution was obtained, and the portion undissolved formed a tenacious, sticky mass, very awkward to work with. By repeated boiling with water under a return cooler, this mass gradually lost its sticky nature. It was then digested alternately with boiling water and alcohol, until at last the mass became pulverulent, and could be ground up in a mortar. The operation of boiling was then repeated many times, the mass being powdered after each treatment with water, until at length the substance in a state of purity was obtained. Its analysis showed it to be diphenylamine-acrolein, or, as it might be termed, diphenylamine-allylene.

| | Found. | Theory. |
|---|---|---|
| Carbon | 86.26 | 86.18 |
| Hydrogen | 6.29 | 6.36 |
| Nitrogen | 7.28 | 7.45 |

It does not melt or sublime, but is decomposed on heating, leaving behind a carbonaceous residue extremely difficult of combustion. It is very slightly soluble in alcohol, insoluble in ether, and readily soluble in chloroform to a dark red liquid. From this solution, and also from that in glacial acid, in which it dissolves to a red liquid, but less readily than in chloroform, it could not be made to crystallize.

Its sclution in chloroform was attacked with great energy by bromine. So also its solution in acetic acid, a dark red compound being formed on the addition of two atoms of bromine to one molecule of the diphenylamine. This compound was readily soluble in chloroform, but as it did not separate in a crystalline condition, its analysis was not made. It was probably the addition-compound $(C_{12}\ H_{10}\ N)_2\ C_2\ H_4\ Br_2$.

Its solution in acetic acid was attacked by nitric acid, forming a precipitate with a supernatant yellow liquid. Neither the solution nor the precipitate yielded a crystallizable nitro-product, and their study was abandoned.

# NEW YORK ACADEMY OF SCIENCES,

Late LYCEUM OF NATURAL HISTORY.

---

The Meetings of the Academy are held at the rooms, No. 12 West 31st Street, on Monday evening of each week, at 8 P. M., from October to May, inclusive, and are open to the public; on the evenings devoted to Public Lectures, admission is only by tickets, which are free, on previous application.

---

## OFFICERS OF THE ACADEMY.

PRESIDENT:

JOHN S. NEWBERRY, *Columbia College, N. Y. City.*

VICE-PRESIDENTS:

THOMAS EGLESTON, BENJ. N. MARTIN.

CORRESPONDING SECRETARY:

ALBERT R. LEEDS, *Hoboken, N. J.*

TREASURER:

JOHN H. HINTON, 41 *West 32nd St.*

RECORDING SECRETARY:

OLIVER P. HUBBARD, 65 *West 19th St.*

LIBRARIAN:

LOUIS ELSBERG, 614 *Fifth Avenue.*

COUNCIL:

DANIEL S. MARTIN, ALFRED C. POST,
GEORGE N. LAWRENCE, WILLIAM P. TROWBRIDGE,
ALEXIS A. JULIEN, LOUIS ELSBERG.

FINANCE COMMITTEE:

T. B. CODDINGTON, PHILIP SCHUYLER, THOMAS BLAND.

COMMITTEE OF PUBLICATION:

D. S. MARTIN, J. S. NEWBERRY, G. N. LAWRENCE,
A. R. LEEDS, W. P. TROWBRIDGE.

---

## ANNALS OF THE NEW YORK ACADEMY OF SCIENCES.

The "Annals," published for over half a century, by the late Lyceum of Natural History, will be continued under the above name by the NEW YORK ACADEMY OF SCIENCES. It is proposed to issue four numbers every year, each number to consist of not less than thirty-two pages (octavo), with or without plates. Price of Yearly Subscription to non-residents of New York City, $3.00, payable in advance, or $1.00 per number; to residents and honorary members, $2.00, or 60 cents per number; to residents of New York City, not members of the Academy, $5.00. The Academy has for sale a number of back volumes of the Annals, each containing twelve or more numbers; the price per volume is $4.00 with uncolored plates, or $5.00 with colored plates.

The Academy has established a Publication Fund, contributors to which, in the sum of $100 at one time, are entitled to all the scientific publications of the Academy, both Annals and Transactions, appearing subsequently to the payment of their contribution.

Communications in regard to both Annals and Transactions should be addressed to

Prof. D. S. MARTIN,

*Chairman of Publication Committee,* 236 *W. 4th St.,*

NEW YORK CITY.